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A POPULATION STUDY OF THE BARROW ISLAND AVIFAUNA

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Summary

Four weeks of intensive field work on Barrow Island (c. 22,260 ha) in August 1976 on the status of birds then present, particularly the Black-and-white Wren and the Spinifex-bird, was mainly concentrated upon their population strength. The count methods are described and the results given in detail. The most numerous species was found to be the Spinifex-bird with 17,800 individuals, followed by the Welcome Swallow, 8,500; the Black-and-white Wren, 8,150; the Tree-Martin, 7,050; the White-breasted Wood-Swallow, 3,450; the Singing Honeyeater, 3,050, and the Kestrel, 1,650. The remaining species were represented by fewer than 1,000 individuals, the most numerous of these being the Horsfield Bronze-Cuckoo with 910 individuals. Sea and shore-birds were the subjects of separate counts.

As holder of the 1976 Barrow Island Research Grant, the writer was domiciled on Barrow Island from August 2 until August 30, 1976. During the whole of this period he was fortunate in having the full co-operation and assistance of Mr. W. H. Butler, Conservation Consultant to WAPET (West Australian Petroleum Pty. Ltd.). Without this assistance the work undertaken would have been impossible.

Descriptions of Barrow Island (area c. 22,260 ha) are available in the following studies, F. Lawson Whitlock (1918, 1919), D. L. Serventy and A. J. Marshall (1964), W. H. Butler (1970, 1975, 1975a) and A. A. Burbidge and A. R. Main (1969).

THE AVIAN POPULATION

Hereunder follows a tabular, annotated summary of the birds so far recorded on Barrow Island, with the authority for each record, an indication of their breeding status and an assessment of population strength as at August 1976.

Column 1 gives the species recorded by F. Lawson Whitlock (in 1917 and 1918). Column 2 gives those listed by D. L. Serventy and A. J. Marshall (in 1958). Column 3 lists the observations published by W. H. Butler (1970, 1975). Column 4 the additional species recorded by Butler but unpublished, and Column 5 the species observed by Butler and myself during the research project now reported. Column 6 is the population strength recorded in August 1976, and Column 7 the source of this information (detailed later in this paper, pp. 99-104).

The following symbols are used: O—sight observation; B—breeding recorded; S—specimen handled, but not necessarily preserved; P—photograph taken.

The Royal Australasian Ornithologists' Union has recently issued lists of amended bird names both vernacular and scientific and these were used in preparing the original report but as some are announced as of an interim character (Schodde, 1975) and several differ considerably from general usage, it has been thought desirable to conform to the names used in previous papers in the Barrow Island series i.e., Butler, 1970 and 1975, as well as with the latest edition of Serventy and Whittell's *Birds of Western Australia*, 1976.

SPECIES	1	2	3	4	5	6	7
Little Grebe, <i>Eudyptula minor</i>				S			
Yellow-nosed Albatross, <i>Diomedea chlororhynchos</i>				S			
Wedge-tailed Shearwater, <i>Puffinus pacificus</i>	B	O	O	S	O	?	
Wilson's Storm-Petrel <i>Oceanites oceanicus</i>		O	O				
Australian Pelican, <i>Pelecanus conspicillatus</i>		O	O	S	O	23 Count	
Masked Booby, <i>Sula dactylatra</i>			O				
Brown Booby, <i>Sula leucogaster</i>			O				
Pied Cormorant, <i>Phalacrocorax varius</i>	B	O	O		O	52 Count C	
Black Cormorant, <i>Phalacrocorax carbo</i>			O				
Lesser Frigate-Bird, <i>Fregata ariel</i>			O	P			
White-faced Heron, <i>Ardea novaehollandiae</i>			S		O	18 .. C	
Little Egret, <i>Egretta garzetta</i>	O						
Reef Heron, <i>Egretta sacra</i>	B	O	B		O	96 .. C	
Mangrove Heron, <i>Butorides striata</i>	B		O		O	15 .. C	
Nankeen Night-Heron, <i>Nycticorax caledonicus</i>					O	.11 Count	
Black Swan, <i>Cygnus atratus</i>			O				
Grey Teal, <i>Anas gibberifrons</i>			O				
Wood Duck, <i>Chenonetta jubata</i>			O				
Osprey, <i>Pandion haliaetus</i>	B	B	B		B	39 Count C	
Black-Shouldered Kite, <i>Elanus notatus</i>			O		O		
Square-tailed Kite, <i>Lophoictinia isura</i>		O					
Black-breasted Kite, <i>Hamirostra melanosterna</i>			O				
Red-backed Sea-Eagle, <i>Haliastur idus</i>	B	B	O		B	15 .. C	
Whistling Eagle, <i>Haliastur sphenurus</i>			O				
White-breasted Sea-Eagle, <i>Haliaeetus leucogaster</i>	B		O		B	12 Estimate	
Wedge-tailed Eagle, <i>Aquila audax</i>	O						
Spotted Harrier, <i>Circus assimilis</i>	O		O		O	180 Count A	
Little Falcon, <i>Falco longipennis</i>			O	S			
Brown Hawk, <i>Falco berigora</i>				O	O	2 Estimate	
Nankeen Kestrel, <i>Falco cenchroides</i>	O	O	B		O	1,650 Count A	
Brown Quail, <i>Synopsis ypsilophorus</i>			O	S			
Bustard, <i>Eupodotis australis</i>			O				
Beach Stone-Curlew, <i>Esacus magnirostris</i>			O		O	3 .. C	
Pied Oystercatcher, <i>Haematopus ostralegus</i>	O?	O	B		B	240 .. C	
Sooty Oystercatcher, <i>Haematopus fuliginosus</i>	O	B	O		O	66 .. C	
Grey Plover, <i>Pluvialis squatarola</i>			P		O	9 .. C	
Eastern Golden Plover, <i>Pluvialis dominica</i>			S		O	12 .. C	
Large Sand-Dotterel, <i>Charadrius leschenaultii</i>		S	S		O	96 .. C	
Oriental Dotterel, <i>Cheradrius veredus</i>			S				
Red-capped Dotterel, <i>Charadrius ruficapillus</i>	B?	B	B		B	231 .. C	
White-headed Stilt, <i>Himantopus himantopus</i>				O	S		
Banded Stilt, <i>Cladorhynchus leucocephalus</i>					S		
Turnstone, <i>Areneria interpres</i>			O		O	183 .. C	

SPECIES	1	2	3	4	5	6	7
Eastern Curlew, <i>Numenius</i>							
<i>madagascariensis</i>		O			O	3 ..	C
Whimbrel, <i>Numenius phaeopus</i>		O	O		O	42 ..	C
Little Whimbrel, <i>Numenius</i>							
<i>minutus</i>			P				
Wood Sandpiper, <i>Tringa</i>							
<i>glareola</i>			O				
Grey-tailed Tattler, <i>Tringa</i>							
<i>brevipes</i>		O	S		O	177 ..	C
Common Sandpiper, <i>Tringa</i>							
<i>hypoleucos</i>		O	O		O	33 ..	C
Greenshank, <i>Tringa nebularia</i>			O		O	9 ..	C
Terek Sandpiper, <i>Xenus</i>							
<i>cinereus</i>					O	1	Count
Black-tailed Godwit, <i>Limosa</i>							
<i>limosa</i>					O	36	Count C
Bar-tailed Godwit, <i>Limosa</i>							
<i>lapponica</i>			O		O	87	Census C
Knot, <i>Calidris canulus</i>					O	10	Estimate
Great Knot, <i>Calidris tenuirostris</i>					O	10	Estimate
Sharp-tailed Sandpiper, <i>Calidris</i>							
<i>acuminata</i>			S		O		
Red-necked Stint, <i>Calidris</i>							
<i>ruficollis</i>		O	O		O	318	Count C
Curlew Sandpiper, <i>Calidris</i>							
<i>ferruginea</i>					O		
Sanderling, <i>Calidris alba</i>					O	27	C
Australian Pratincole, <i>Stiltia</i>							
<i>isabella</i>			O				
Silver Gull, <i>Larus</i>							
<i>novaehollandiae</i>	O	O	B	BS	O	592	Count C
Caspian Tern, <i>Hydroprogne</i>							
<i>caspia</i>	B	O	O		B	63 ..	C
Gull-billed Tern, <i>Sterna nilotica</i>					O	3 ..	C
Common Tern, <i>Sterna hirundo</i>				S			
Roseate Tern, <i>Sterna dougallii</i>			O				
Bridled Tern, <i>Sterna anaetheta</i>			O				
Fairy Tern, <i>Sterna nereis</i>				O	B	100	Estimate
Crested Tern, <i>Sterna bergii</i>		O	O		O	96	Count C
Lesser Crested Tern, <i>Sterna</i>							
<i>bengalensis</i>					O	57 ..	C
Lesser Noddy, <i>Anous</i>							
<i>tenuirostris</i>			S				
Peaceful Dove, <i>Geopelia striata</i>	O						
Bar-Shouldered Dove, <i>Geopelia</i>							
<i>humeralis</i>	B	SB	B		O	180 ..	A
Galah, <i>Cacelua roseicapilla</i>			O				
Little Corella, <i>Cacatua</i>							
<i>sanguinea</i>			O				
Budgerygah, <i>Melopsittacus</i>							
<i>undulatus</i>			O				
Pallid Cuckoo, <i>Cuculus pallidus</i>					O	3	Estimate
Black-eared Cuckoo,							
<i>Chrysococcyx osculans</i>			O				
Horsfield Bronze Cuckoo,							
<i>Chrysococcyx basalis</i>			P		O	910	Count A
Boobook Owl, <i>Ninox</i>							
<i>novaeseelandiae</i>			O	S	?	6	Estimate
Barn Owl, <i>Tylo alba</i>				S	O	6	Estimate
Spine-tailed Swift, <i>Hirundapus</i>							
<i>caudatus</i>				O			
Fork-tailed Swift, <i>Apus pacificus</i>				S			
Sacred Kingfisher, <i>Halcyon</i>							
<i>sancta</i>	O	S	O		O	12 ..	C
Welcome Swallow, <i>Hirundo</i>							
<i>neoxena</i>	O	O	B		B	8,500 ..	A
Tree-Martin, <i>Petrochelidon</i>							
<i>nigricans</i>		O	O		O	7,050 ..	A
Fairy Martin, <i>Petrochelidon</i>							
<i>ariel</i>			O				
Australian Pipit, <i>Anthus</i>							
<i>novaeseelandiae</i>	SB		O		O	50	Estimate

SPECIES	1	2	3	4	5	6	7
Black-faced Cuckoo-Shrike, <i>Coracina novaehollandiae</i>			O		O	15	Estimate
White-winged Triller, <i>Lalage</i> <i>sueurii</i>			O				
Spinifex-bird, <i>Eremiornis carteri</i>	SB	SB	O		O	17,800	Count A
Brown Songlark, <i>Cinclorhamphus cruralis</i>			B		O	6	Estimate
Black-and-white Wren, <i>Malurus</i> <i>leucopterus</i>	SB	SB	B		O	8,150	Count A
Spiny-cheeked Honeyeater, <i>Anthochaera rufogularis</i>	O						
Singing Honeyeater, <i>Meliphaga</i> <i>virescens</i>	B		B		O	3,050	Count A
Yellow Silver-eye, <i>Zosterops</i> <i>lutea</i>	S		B		O	20	Estimate
Painted Finch, <i>Emblema picta</i>			O				
Zebra Finch, <i>Poephila guttata</i>	B		O	B	O	100	Estimate
Maggpie-Lark, <i>Grallina</i> <i>cyanoleuca</i>			O		O	6	Estimate
White-breasted Wood-Swallow, <i>Artamus leucorhynchus</i>	O	SB	O		O	3,450	Count A
Masked Wood-Swallow, <i>Artamus personatus</i>			B				
Black-faced Wood-Swallow, <i>Artamus cinereus</i>		S		O			
Little crow, <i>Corvus bennetti</i>			O				

Birds recorded on Barrow Island may be provisionally categorized as follows:

A. REGULAR MIGRANTS

At first sight this appears a clear-cut category. However reports indicate that there are always some migrant waders present—there are far more “over wintering” individuals than are to be seen in more southerly parts of the State. This matter could well receive attention from observers during the southern winter. We found 14 species of recognised migrant waders within a few days of our arrival, i.e. during the first half of August, and most of these were present in some strength. Some showed traces of breeding plumage. Yet Maud D. Haviland (1926, p. 169) writes: “On the Yenisei tundra the advance guard of birds appears about the beginning of June, but the main body does not arrive until later in the month . . . snow does not disappear until the beginning of July . . . there is at most eight or ten weeks in which to pair, build the nest, hatch the eggs and rear the chicks”. And discussing the southward migration she states (p. 175): “The birds of the polar basin begin their southward migration very early. Already by the end of August our [British] coasts are invaded by parties of waders, generally young birds . . .” On the Yenisei tundra “July and August are the summer months . . . The end of August sees the last of the fine weather . . . the last birds depart . . . By the middle of September the land is white . . .” The Year Cycle Charts by James Fisher (1947, vol. 1) confirm these patterns.

The presence of numbers of Palaearctic waders in Latitude 20° South in August or earlier requires explanation. Mr. R. B. Sibson, of Auckland, New Zealand, tells me that his observations suggest that some immature birds do not migrate to Siberia but remain in warmer regions, e.g., the Pacific islands, though they leave the more southerly areas, e.g. New Zealand, during the southern winter.

The regular migrants to Barrow Island are the following:

Grey Plover	Bar-tailed Godwit
Golden Plover	Knot
Large Sand-Dotterel	Great Knot
Oriental Dotterel	Sharp-tailed Sandpiper
Turnstone	Red-necked Stint
Eastern Curlew	Curlew Sandpiper
Whimbrel	Sanderling
Little Whimbrel	Pallid Cuckoo
Wood Sandpiper	Horsfield Bronze-Cuckoo
Grey-tailed Tattler	Spine-tailed Swift
Common Sandpiper	Fork-tailed Swift
Greenshank	Sacred Kingfisher
Terek Sandpiper	White-winged Triller
Black-tailed Godwit	

B. IRREGULAR NON-MARITIME VISITORS

These are species not recognised as regular migrants which have been recorded on Barrow Island but which are almost certainly not present at all times. In some cases the presence of standing fresh water may be decisive, e.g. with water-fowl.

Little Grebe	Galah
White-faced Heron	Little Corella
Little Egret	Budgerigah
Nankeen Night-Heron	Black-eared Cuckoo
Black Swam	Barn Owl
Grey Teal	Fairy Martin
Wood Duck	Black-faced Cuckoo-Shrike
Square-tailed Kite	Brown Songlerk
Black-breasted Kite	Spiny-cheeked Honeyeater
Whistling Eagle	Crimson Chat
Wedge-tailed Eagle	Yellow Silver-eye
Little Falcon	Painted Finch
Brown Hawk	Zebra Finch
Brown Quail	Maggie-Lark
Bustard	Masked Wood-Swallow
Australian Pratincole	Black-faced Wood-Swallow
Peaceful Dove	Little Crow

C. MARITIME SPECIES

Individuals of some of these appear to be present at all times and there may well be a resident population, while others are wide-ranging species which occur only at times, e.g. boobies and Lesser Frigate-bird.

Wedge-tailed Shearwater	Pied Oystercatcher
Yellow-nosed Albatross	Sooty Oystercatcher
Wilson's Storm-petrel	Red-capped Dotterel
Australian Pelican	Silver Gull
Masked Booby	Gull-billed Tern
Brown Booby	Casplan Tern
Pied Cormorant	Common Tern
Black Cormorant	Roseate Tern
Lesser Frigate-bird	Bridled Tern
Reef Heron	Fairy Tern
Mengrove Heron	Crested Tern
Osprey	Lesser Crested Tern
Red-backed Sea-Eagle	Lesser Noddy
Beach Stone-Curlew	

D. RESIDENT LAND BIRDS

The thirteen species included here are birds which appear to be always present and the populations appear to be stable:

Black-shouldered Kite	Tree-Martin
White-breasted Sea-Eagle*	Australian Pipit
Spotted Harrier	Spinifex-bird
Nankeen Kestrel	Black-and-white Wren
Bar-shouldered Dove	Singing Honeyeater
Boobook Owl	White-breasted Wood-Swallow
Welcome Swallow	

*The White-breasted Sea-eagle presents a problem. Unlike the Osprey and the Red-backed Sea-Eagle, it does not confine its activities to the coast but ranges and forages over most of the island, thus contriving to be both a land bird and a maritime species. Nest debris, examined on numerous occasions by W.H.B., proved to be terrestrial rather than marine in origin.

A SPECIES LIST

With Notes on Distribution and Breeding

Throughout the investigation on Barrow Island localities of all individual birds recorded were plotted on separate species maps.

Birds recorded in previously published lists but not encountered during this survey were in most cases almost certainly absent and were not included in this list unless some comment appeared desirable.

An asterisk indicates a species not previously recorded for Barrow Island.

**Diomedea chlororhynchos*, Yellow-nosed Albatross.

Since my return from Barrow Island, W.H.B. has advised me of a further new record—a bird of this species which he collected on the west coast of the island on February 8, 1977, as a beach derelict. Identification was confirmed by the Western Australian Museum and the skull retained. This record is within the recognized range of the species but is outside the area in which it is known to occur commonly.

Puffinus pacificus, Wedge-tailed Shearwater.

No birds were seen. Burrows on Double Island (visited August 19, 1976) were evidently in use—recent tracks were discernible at burrow entrances. From one burrow a moaning call was heard, indicating, perhaps, courtship. Burrows noted were towards the centre of the northern part of the Island and were excavated under cap rock. There were a few burrows on the western side of Mushroom Island, also under cap rock.

Pelecanus conspicillatus, Australian Pelican.

A flock of 23 birds was usually to be found on an islet in Bandicoot Bay. Apparently the birds left the island in groups at low tide and could then be seen foraging off-shore.

Phalacrocorax varius, Pied Cormorant.

Birds were usually seen congregated on a rocky foreshore or flying off-shore in skeins, presumably to or from fishing grounds. Principal congregations noted were at Perentic Two—51 birds, Bandicoot Bay—c. 40 birds, Mushroom Island—c. 50 and Double Islands—c. 55. (The last two records could well refer to the same flock).

Ardea novaehollandiae, White-faced Heron.

As there was no standing fresh water on the island it was not surprising to find that these birds were present only upon inshore reefs and usually near the outer edge. Our distribution map for the species suggests that the birds strongly favoured the southern part of the island. Excepting one record at Turtle Bay, all were on the south or south-west coasts. Five was the largest number seen at any one time.

Egretta garzetta, Little Egret.

Not encountered. The species was recorded by F. Lawson Whitlock on his first visit in 1917. This record was omitted from lists published by later investigators. We were particularly watchful and whenever possible viewed white-plumaged egrets closely. All seen proved to be Reef Herons. However, there appears to be no reason why the Little Egret should not occur as there is plenty of apparently suitable coastal habitat available.

Demigretta sacra, Reef Heron.

At various times a total of 66 birds was recorded. Of these 19 were white-phase birds. From these figures it may be deduced that the proportion of white-phase birds at Barrow Island is 29% with a 95% probability that the lower limit is 19% and the upper limit 41%. Birds frequented all types of shores, usually in pairs, sometimes singly; it was rare to find a stretch of shore without at least one bird.

Butorides striatus, Mangrove Heron.

This species was encountered only at Mattress Point, Stokes Point, Perentic One and Perentic Two; all localities where mangroves occur.

All records were of the red form. (Whitlock mentions "a still smaller bittern"—a puzzling reference. No habitat which I would regard as being suitable for the Little Bittern occurs.)

**Nycticorax caledonicus*, Nankeen Night Heron.

On August 23, eleven birds, all in adult plumage, were flushed from mangroves near Stokes Point. No evidence of breeding was seen.

Pandion haliaetus, Osprey.

All records of birds were made on or near the coast and, with a few exceptions, in the sandy south-west corner of the island, all nests were on the coast, usually situated on rocky headlands, cliffs or rocky islets. In a few cases work sites have been utilized, e.g. at Town Point and on an 'off-shore' drilling site connected to the island by a causeway at Bandicoot Bay east. Twenty-three nests are known on Barrow Island but these are not necessarily all used at one time. Our beach count shows 39 birds which is reasonably consistent and suggests that a population of c. 20 pairs is likely. Nests inspected contained: Two downy young and one (? infertile) egg (August 3), Two eggs (August 3—and revisited August 30, when two young were half fledged). Two downy young and one egg (August 4). Two eggs and one newly hatched chick (August 19, Double Island). Two chicks at an advanced downy stage (August 29).

Elanus notatus, Black-shouldered Kite.

These birds seemed to favour the southern and the northern thirds of the island: an alternative interpretation would be an avoidance of the higher, rocky and sparsely vegetated west and west central part of the island.

Haliastur indus, Red-backed Sea-Eagle.

With one exception, all sightings of birds were on or near the coast and all nests known—six—are on the coast. Five of these nests are in mangroves, *Avicennia*. Our beach census gives a count of 15 birds which is consistent with a population of 6 pairs. A nest near Stokes Point, examined on August 23, contained one downy chick just beginning to fledge and one cold egg, dimensions 58.1 by 41.7 mm. On August 29, W.H.B. located a nest at Turtle Bay containing two fledged young. An old nest at Mattress Point, situated 2.5 m from the ground in a mangrove, contained the remains of many grapsid crabs—surprisingly, the chelae were unbroken.

Haliaeetus leucogaster, White-breasted Sea-Eagle.

Unlike the Osprey and the Red-backed Sea-Eagle, this species ranges well inland, though it appears to avoid the high, rocky country of the west central area. One bird observed among *Triodia* in a valley three kilometres inland proved to be with a kill—a Hare Wallaby, *Lagorchestes conspicillatus*. All known nests—eight—are on the coast or on islets, e.g. Double Island and Pasco Island. The beach count gives only three birds—hardly consistent with six nests on the main island or with our fairly frequent records of birds quartering the inland areas, though the low beach count could be explained by the tendency of these birds to forage inland. A nest inspected on August 10, contained two chicks in the down.

Circus assimilis, Spotted Harrier.

These birds are a familiar sight over most of the island—only the west-central area being avoided. They are probably wide-ranging, so the number of sightings may not reflect accurately the actual number present, but I would say that they are more frequent on Barrow Island than in any other area that I have examined.

**Falco berigora*, Brown Hawk.

This species was encountered on only four occasions—thrice within three kilometres of WAPET Headquarters and once to the north-east of Flacourt Bay. Quite possibly only two birds were present on the island. All records were of dark birds.

F. cenchroides, Nankeen Kestrel.

This is the most widely distributed and probably the most frequent bird of prey on the island. They may show some slight preference for the coastal strip—which is explained in part, perhaps, by the abundance of suitable cliff nesting sites. Birds are rather frequently observed perched on termitaria.

Burhinus magnirostris, Beach Stone-Curlew.

We twice encountered a single bird on the muddy inshore reefs at Mattress Point.

Haematopus ostralegus, Pied Oystercatcher.

These birds may be encountered on almost any beach, even rocky foreshores. Two nests were located to the west of Stokes Point on August 25, one just above high water mark containing one egg, the other 13 metres above high water mark contained two eggs.

H. fuliginosus, Sooty Oystercatcher.

This bird has a similar distribution to the preceding species showing no marked preference for any particular type of shore.

Pluvialis squatarola, Grey Plover.

Birds were located on three beaches, all in the south-west of the island. A party of nine seen on August 25 at Bandicoot Bay included one bird in transition plumage suggesting that this party at least might be newly arrived from the breeding grounds.

P. dominica, Eastern Golden Plover.

This species was located in only two localities—two birds to the west of Stokes Point and parties of three and of four birds at Mattress Point.

Charadrius leschenaultii, Large Sand-Dotterel.

This proved to be one of the more generally distributed waders. They were frequently encountered on inshore reefs foraging singly or in small parties.

C. ruficapillus, Red-eapped Dotterel.

Records are mainly from the eastern and southern beaches with muddy inshore reefs and sand. Three nests were located, all on oil drilling sites, one on the coast, one 260 m inland and one 800 m inland. The first was located on August 9, the second on August 26 and the third on August 7. Each contained two eggs.

**Cladorhynchus leucocephalus*, Banded Stilt.

The remains of a bird found on a rocky shore near WAPET Camp were identified by the Western Australian Museum which, in view of the unusual locality, is retaining a leg and a wing.

**Himantopus himantopus*, White-headed Stilt.

Three observed on January 29, 1976, by W.H.B. on a claypan at South End.

Arenaria interpres, Turnstone.

Fairly widely distributed on the inshore reefs. Pebbles generally are lacking, but in a few instances birds were seen to turn loose reef material.

Numenius madagascariensis, Eastern Curlew.

Single birds were recorded at Mattress Point and at Bandicoot Bay.

N. phaeopus, Whimbrel.

Birds were observed in small parties or, more often, singly, on eight beaches.

Tringa brevipes, Grey-tailed Tattler.

Flocks were occasionally encountered e.g. 24 at Mattress Point on August 4 and 27 at Mattress Point on August 11, but usually birds occurred

singly or in small parties on the inshore reefs. They were among the more frequently encountered waders.

T. hypoleucos, Common Sandpiper.

Usually encountered singly or in pairs on inshore reefs.

T. nebularia, Greenshank.

Noted singly or in small parties on sheltered beaches viz.: Mattress Point, Tank Farm beach and on the south coast.

**Xenus cinereus*, Terek Sandpiper.

One encountered to the west of Stokes Point on August 23. It was immediately recognisable by its orange legs, up-turned bill and white brow. This proved to be the only one seen: it is apparently less frequent here than in similar habitat near Cairns.

**Limosa limosa*, Black-tailed Godwit.

Identified at two localities in the south-west of the island.

L. lapponica, Bar-tailed Godwit.

This appears the commoner of the two godwits on Barrow Island and it seems probable that godwits seen at Flacourt Bay were of this species. All other records were for the south coast where this species was identified on a number of occasions.

**Calidris canutus*, Knot.

While we were observing Great Knots on the intertidal flats to the west of Stokes Point, W.H.B. drew attention to some slightly but definitely smaller birds with similar stance and rather plump, squat appearance. Their underparts were plainer than those of the Great Knots but these were possibly in transition plumage.

**C. tenuirostris*, Great Knot.

Several were observed with other waders on a sheltered beach near Stokes Point on August 23. Noted: Moderately long, straight, blackish bill. Stoutish legs. appearing blackish. Larger than Tattler and Curlew Sandpiper—smaller than Godwit. Wing streaky. Dark line through eye. Chest mottled with blackish scallops. White bar on upper tail visible in flight. There was a little variation in plumage within the flock, but the foregoing description is typical. I would judge the birds to be in transition plumage, or even in breeding plumage. It is perhaps significant that these birds were not recorded until August 23—possibly newly arrived migrants. Most illustrations show the Great Knot as much plainer below than the birds I encountered. However, the figure in *Birds of the World*—Austin and Singer, is strikingly similar. The same—or similar—birds were encountered at Bandicoot Bay on August 25.

C. acuminata, Sharp-tailed Sandpiper.

On August 16 we encountered three birds, one in non-breeding plumage, the others with a trace of rufous on their underparts—possibly juvenile birds or birds retaining a trace of breeding plumage.

C. ruficollis, Red-necked Stint.

This species proved to be frequent on the southern and eastern beaches of the island. It was usually encountered in small parties but on August 11 we noted 40 at Mattress Point and on August 23 "a large number i.e. hundreds" to the west of Stokes Point, a few with noticeably reddish-plumage on the neck. In the same area on August 25 a few birds were noted with rufous cheeks and breasts. It appears likely that the number present increased during the course of the month.

**C. ferruginea*, Curlew-sandpiper.

We recorded this species sparingly on the south coast but not until August 16. At least one seen displayed chestnut-red below—apparently a bird in transition plumage. The whitish rump pattern was noted on three occasions.

**C. alba*, Sanderling.

Five birds were noted on Whites Beach, six on a beach near Cape Dupuy, five on a sandy beach in Bandicoot Bay and one on a beach west of Stokes Point. Noted: Shortish black bill. Dull black legs. Wings pale grey with black shoulder and leading edge (some only). Head and underparts, white; neck pale. Tail pattern, in flight, white with narrow dark centre. In size the birds were less than Turnstone and Large Sand-Dotterel and greater than Red-necked Stint and Red-capped Dotterel. The bird seen singly impressed me as being very active.

Larus novaehollandiae, Silver Gull.

Silver Gulls could be seen on most beaches but not in large numbers—c. 20 at the most. Only near WAPET Camp could large numbers be anticipated: a careful estimate made at a favourable time was 430. The birds usually kept close to the shore line but at c. 1715 hrs on August 16, following rain, many gulls were ranging up to two kilometres inland in the area just to the north of the Camp and were catching ants on the wing.

**Gelochelidon nilotica*, Gull-billed Tern.

On August 9 we observed one bird in flight and perched on the seaward edge of the reef at a beach on the south-west coast, and, on August 25, three birds at Bandicoot Bay. All birds seen were in winter plumage i.e. with nape and back of crown only faintly marked with grey.

Hydroprogne caspia, Caspian Tern.

Caspian Terns were seen mainly in twos and threes on most beaches. On August 7, three birds were seen flying over a shoal of dolphin, *Tursiops truncatus*, diving from time to time, though not actually into the water. They followed the dolphins along the southern shore of the island into Bandicoot Bay. I would suppose that the birds were interested in securing prey disturbed by the dolphins. On August 19 two downy chicks were located on a cliff top at the southern end of Mushroom Island. Nearby an egg was located—dimensions 70.2 by 44.0 mm—but this appeared rather old and not necessarily contemporaneous with the chicks.

**Sterna hirundo longipennis*, Common Tern.

A specimen forwarded to the Western Australian Museum by W.H.B. at some time prior to this investigation was identified and retained—specimen no. 14427.

**S. nereis*, Fairy Tern.

Small flocks and single birds were noted on a number of beaches, mainly on the east and south coasts. We were watchful for Little Tern, *S. albigrons*, which, I feel, could occur in this area, if only as a straggler, but all small tern definitely identified were *S. nereis*. Three or four birds with dark or parti-coloured bills were assumed to be juveniles. W.H.B. was surprised to find that this species had not been previously listed for Barrow Island as he was aware of its occurrence. A colony of 90 to 100 birds was nesting on the eastern end of Mushroom Island; c. 45 nests were grouped quite closely, some only 300 to 500 mm apart. The majority contained eggs, many one egg, some two and a few, three, and the remainder chicks in the down. It was considered inadvisable to procure more precise data, a procedure which would have taken some time and caused a prolonged disturbance of the birds, but the foregoing estimates were made with some care.

S. bergii, Crested Tern.

It was anticipated that *S. bengalensis* would occur on Barrow Island, so all crested terns were examined as closely as possible and the majority was definitely identified. Crested Terns were encountered on eight beaches, with probable records on two others, in parties of two or three. At Perentie Two a flock of 28 crested terns was encountered, but this was a mixed flock. W.H.B. found one egg just above high water mark. This was lodged at the Western Australian Museum in October 1975—specimen no. A 14428.

**S. bengalensis*, Lesser Crested Tern.

Eight birds were identified at Perentie Two, four birds, one immature, at Flacourt Bay, three birds, one immature, at WAPET Landing, two birds to the west of Stokes Point and an uncertain number in a flock of 28 Crested Terns at Perentie Two. In each case the orange-yellow bills were plainly discernible.

Geopelia striata, Peaceful Dove.

This species was recorded by F. Lawson Whitlock (1917) but the record has been omitted from later lists. The occurrence of this species as a straggler appears by no means improbable.

G. humeralis, Bar-shouldered Dove.

It is hard for one accustomed to meeting this species in the riparian forests of northern Australia to accept the fact that on Barrow Island the birds are almost completely adapted to life in the *Triodia*. There is some slight dependence upon such trees as occur for nesting sites, but W.H.B. has located nests in rock cavities. Apart from a suggestion of concentration round WAPET Headquarters and round WAPET Camp there is at first sight little in the species' distribution map to indicate that occurrence on the island is regulated by water supply; it seems likely that the birds travel some distance to drink. There is a slight suggestion of preference for coastal localities. Analysis of the 23 localities at which birds were recorded shows that 9 (39%) were within 0.5 km of the shore, but of these 7 (30%) were also within 0.5 km of a water source and only 2 (8.7%) were near the coast but not near fresh water. Of the whole, 11 (48%) were within 1 km of water. The foregoing figures exclude the two known island populations—Double Island and Mushroom Island. The inclusion of these would strengthen a case for coastal preference. It would seem that water is the dominant preference but that a coastal preference is significant: if the birds travel to water once or twice daily, the percentage of records near water may not reflect the species' real 'domicile' and one is left with a fairly well-marked preference for coastal areas. Old nests were located in stunted trees and in rock cavities, usually between one and two metres from the ground. One such nest 1.7 m from the ground in a *Eucalyptus patellaris* in the Valley of the Giants contained the remains of two eggs, one, nearly intact, measuring 27.3 by 20.1 mm.

Cacatua roseicapilla, Galah.

Not encountered; Mr. Davis, W.T. operator on Barrow Island, reported a recent visit of a flock of c. 40 birds.

**Cuculus pallidus*, Pallid Cuckoo.

One bird was recorded near WAPET Camp on August 3, one near the southern end of the island on August 7, and one in the same general locality on August 14. Possibly only one bird was present.

Chrysococcyx basalis, Horsfield Bronze Cuckoo.

During the period of the research project these birds were very frequent—perhaps more frequent than in any other area in which I have encountered this species. Calls were frequently heard and groups of up to at least five birds were not uncommon, from which I would suppose that courtship was proceeding. No young were seen. The host species would be, presumably, the Black-and-white Wren. Birds were usually associated with shrubs but needed only a minimum of such cover. The species was widely distributed though records were infrequent in the thinly vegetated central part of the Island.

Ninox novaeseelandiae, Boobook Owl.

Singing Honeyeaters were 'mobbing' a bird which may have been of this species at Mattress Point, but satisfactory views were not obtained.

**Tyto alba*, Barn Owl.

W.H.B. had an unpublished record of this species which he first observed in November 1975. If this were a resident species it would surely have been recorded earlier, especially as W.H.B. has done much spotlighting for mammals. It seems likely that the bird is an irregular visitor to the island. The same could be said of the Boobook Owl. On August 16, at c. 1700 hrs, we investigated a report of an owl in a store at Tank Farm. We flushed a Barn Owl from a nearby engine shed whence it flew to an adjacent roof. Two Kestrels then attacked the owl with vigour, dislodging some plumage. A few typical pellets were collected from the engine shed.

**Hirundapus caudacutus*, Spine-tailed Swift.

Recorded by W.H.B. prior to the time of this present research project.

Halcyon sancta, Sacred Kingfisher.

Birds were recorded, usually singly, at Mattress Point, WAPET Camp, Perentie Two and near Stokes Point. All, except the camp, were localities with mangroves, *Avicennia*. The possibility of Mangrove Kingfishers, *H. chloris*, being present was not overlooked, but all birds seen and heard (they were rather silent) appeared to be of this species. Birds were present throughout the time that we were on the Island. W.H.B. has recorded birds throughout the year.

Hirundo neoxena, Welcome Swallow.

The species map shows Swallows to be widespread with an indication of preference for coastal areas: the ridge in the west-centre of the island seems to be avoided. Only one occupied nest was located—on the top of a ventilator at the Mess in WAPET Camp. The nest had been used previously and the edge had been raised almost to the roof, making entry—and inspection—difficult. Three young left the nest on August 26. A bird seen about a building near the heliport was carrying a shred of canvas but we could not locate a nest.

Petrochelidon nigricans, Trec-Martin.

The distribution map for this species shows a preference for coastal areas, though not the actual beaches, with some extension inland in both north and south to include the claypan areas.

Anthus novaeseelandiae, Australian Pipit.

Five Pipits were noted at a claypan area to the east of Cape Poivre and single birds in each of four localities in the southern part of the island. Four of these localities are in or adjacent to claypan areas.

Coracina novaehollandiae, Black-faced Cuckoo-Shrike.

On five occasions up to four birds were seen a little to the west of WAPET Landing, on two occasions one bird was seen at WAPET Camp, two were seen at the Valley of the Giants and a flock of ten was seen to the south of WAPET Headquarters.

Eremiornis carteri, Spinifex-bird.

Spinifex-birds were recorded wherever there was *Triodia*, i.e. over 93% of the island. Indeed two were seen in *Spinifex longifolius* on coastal dunes, though this was adjacent to *Triodia*. In places, *Triodia* extends to high water mark. Hence the bird is fairly evenly distributed over practically the whole island. Dew bathing was observed. The birds—there were at least two—called, wallowed in *Triodia*, perched on a clump, fluffed out their feathers and sang. On August 27 an apparent display was observed. A bird called from an elevated perch—a purring call followed by a triple note. One wing was raised while the other was fluttered to accompany the call. A second bird was present suggesting that this might be a courtship display. Generally however, the birds were hard to observe. Though probably not particularly shy, they spend most of their time in *Triodia* clumps and usually appear only briefly. Three birds were occasion-

ally encountered together, but we gained a strong impression that two was the mode.

Cinchorhampus cruralis, Brown Songlark.

A bird was heard and seen by W.H.B. at WAPET Camp on August 8 and one heard on August 12 at the Valley of the Giants.

Malurus leucopterus, Black-and-white Wren.

This species is widely and fairly evenly distributed throughout the *Triodia* areas: in this respect it is rivalled only by the Spinifex-bird. Though these birds show a partiality for the usually rather sparse shrubs they also are birds of the *Triodia* and apparently favour the top of a clump of *Triodia* as a nest site. Information on the average number of birds in a group would have been invaluable in our survey. A search of the literature available produced only one relevant reference, "Helpers at the Nest in Australian Passerines", by C. Harrison, *Emu*, 69, p. 32: "... parties of up to ten in the breeding season with one full plumaged male." This reference was to the species' mainland ally, *Malurus leuconotus*. On Barrow Island, five was the largest number of birds we encountered together and with never more than one fully-plumaged cock. W.H.B. when spotlighting for mammals has not infrequently encountered parties roosting, usually on a dead *Trichodesma* or other relatively high perch. Such parties usually comprise no more than five, usually four. Only disused nests were found. One, with two eggs, was taken from the top of a low bush. Dimensions of the eggs were 15.5 by 12.1 mm and 15.7 x 11.8 mm. Two other nests were situated on the tops of clumps of *Triodia*.

Meliphaga virescens, Singing Honeyeater.

The range of this species on Barrow Island is comparable with that of the Spinifex-bird and of the Black-and-white Wren even though it is not a bird of the *Triodia*: indeed its range extends beyond the *Triodia* to the coastal vegetation and to the WAPET Camp. *Avicennia*, *Eucalyptus*, *Ficus*, *Erythrina* and, apparently, any of the shrubs meet the needs of these birds. Individuals were observed probing *Hakea suberea* and *Pittosporum phylliracoides* flowers. At WAPET Camp I suspected the birds of utilising the lighting system to extend their normal hours of activity. Certainly I observed them at first light clinging to a render wall below a lamp and apparently catching insects. Birds have nested at the WAPET Camp: an old site in an ornamental Tuart, *Eucalyptus gomphocephala*, was inspected. During the latter part of our stay a nest was commenced in a shrub near the Mess, but it was not completed.

**Ephthianura tricolor*, Crimson Chat.

W.H.B. observed five birds at the old unsealed airstrip near Airport Creek on January 23, 1975.

Zosterops lutea, Yellow Silver-eye.

We saw this species only in the mangroves to the west of Stokes Point—two birds on August 23 and c. 12 birds on August 26. On both occasions strong winds made detailed observation impossible. Such calls as I heard appeared to resemble those of the Western Silver-eye, *Z. gouldi*.

Poephila guttata, Zebra Finch.

This species appears to have a rather restricted distribution on the island: we found it only in the northern part where it was associated with the claypans (*Agrostis*) and the *Erythrina* in the same general area—and at the Airport where the artificial water supply could be an attraction. The largest flocks encountered—c. 15 and c. 12—were at temporary pools in the claypan area on August 16, rain having fallen the previous day. *Erythrina* appears to be favoured for nesting: a number of apparently disused nests was found. Some at least of these appeared to be breeding nests, i.e. not roosting nests.

Grallina cyanoleuca, Magpie-lark.

Single birds were noted on three occasions—twice (August 3 and 16) to the east of Bandicoot Bay, and once at WAPET Camp.

Artamus leucorhynchus, White-breasted Wood-Swallow.

We found these birds fairly frequent in northern, eastern and southern parts of the island, but apparently absent from the western and central areas.

ASSESSMENT OF THE LAND BIRD POPULATION

Considering the four categories of birds defined earlier, it appeared probable that the land birds were the most likely to be affected by human activity on Barrow Island. Of these species the one immediately attracting attention was the Black-and-white Wren. Of next most importance from the conservation angle was the Spinifex-bird. Both birds occupy similar habitat—one which dominates almost the whole island—so an effort to determine as accurately as possible the population of these birds was given priority. In considering method, it soon became apparent that with only 13 species of resident terrestrial birds any count of the *Triodia* population could well embrace the whole.

As the *Triodia* on Barrow Island occupies 21,700 ha, at first sight an attempt to assess the avian population of such an area may appear so ambitious as to border on absurdity. However, the limited number of species, lack of identification problems and the generally uniform habitat all favoured a sampling enterprise. Above all, such an attempt appeared desirable: it is generally accepted that such statements as "frequent", "rare", or "more frequent than at the time of our previous visit" are highly subjective. Hence my decision to attempt a numerical assessment setting out in detail the methods employed so that a future worker may carry out a study which will provide a valid comparison or may repeat the project if he so desires.

METHOD OF SAMPLING: COUNT A

(a) A quadrat with an area of 0.5 ha was used.

(b) Ideally the positions of the quadrats would have been determined by a grid, but conservation measures in force on the island prohibit the use of vehicles except on recognized roads or tracks. It was expedient, therefore, to use roads for access and place quadrats at 1.2 km intervals on the left hand side along tracks selected to produce, in effect, a grid distribution of quadrats. The necessity for reasonable access will be appreciated when it is understood that a distance of 2,400 km was travelled while making these counts. One hundred quadrats had been proposed, but it was found that eighty adequately covered the area.

(c) Three counts, each of fifteen minutes duration were made at each quadrat.

(d) The first and second counts were made in the mornings—0700 hours to 1130 hours. The third count was made in the afternoon—1300 hours to 1730 hours. In practice the second and third counts were made in parallel.

(e) Birds in flight over the quadrat were included in the count—this to accommodate the aerial foragers. Efforts were made to ensure that, as far as possible, a bird making several traverses was counted once only.

(f) A description was made of each quadrat in terms of vegetation, terrain and disturbance.

(g) Both observers worked together on all occasions, from the periphery of the plot, when this was practicable. Audubon Bird Calls were used as these proved effective in bringing Spinifex-birds into view: other species seemed little influenced.

COUNT A: ANALYSIS OF *TRIODIA* SURVEY

The total number of birds of each species recorded in the three counts at the 80 quadrats was averaged and multiplied by 180—i.e., 21,700 ha, the total area of the *Triodia* habitat, divided by 120 ha, the area represented by 240 observations of 0.5 ha quadrats; to give the estimated total population figure.

The results are summarized in the following table:

SPECIES	Estimated Population	SPECIES	Estimated Population
Spinifex-bird	17,800	Large Sand-Dotterel	350
Welcome Swallow	8,500	Bar-shouldered Dove	180
Black-and-white Wren	8,150	Spotted Harrier	180
Tree-Martin	7,050	Silver Gull	180
White-breasted Wood-Swallow	3,450	Pallid Cuckoo	180
Singing Honeyeater	3,050	Grey-tailed Tattler	180
Nankeen Kestrel	1,650	Osprey	180
Horsfield Bronze Cuckoo	910	Pied Oystercatcher	180
Australian Pipit	350	Caspian Tern	180

COMMENTS ON RESULTS OF COUNT

Figures for the Charadriiformes and the Osprey are almost undoubtedly unsatisfactory i.e. they are too high. These species are accidental to the *Triodia* being surveyed: the individuals seen appeared to be taking short cuts from one shoreline to another. The Australian Pipit could also be considered accidental to the *Triodia*, being rather a bird of the *Agrostis* elaypans. The Pallid Cuckoo seen, though in proper habitat, was possibly the only one on the island: the species was not present in numbers.

There may have been a case for excluding the species mentioned above from the count, but it was deemed advisable to give all species counted consistent treatment.

Figures for the remaining species, i.e. for those distributed throughout the *Triodia*, are presented with confidence. It was to accurately assess these populations that the method was designed.

There appears to be no significant difference between counts made within the present oil field and those made in the so-far unexploited area. However in this connection it should be observed that even outside of the oil field, a certain amount of disturbance has taken place—roads, tracks, gravel extraction areas and special installations e.g. WAPET Landing and Tank Farm.

THE DISTRIBUTION OF *TRIODIA* AVIFAUNA

At the conclusion of Count A, the 'best' and 'worst' quadrats were selected on the basis of the number of birds recorded. In determining the quality of quadrats, we were influenced by the presence or absence of supposedly resident species—Spinifex-bird, Black-and-white Wren and Singing Honeyeater—rather than by the aerial feeders and raptors. These quadrats were plotted on maps, but no very obvious pattern emerged except that our subjective impression that the high, rocky country of the west side of the island was unfavourable to bird-life was confirmed.

A critical field re-examination of these quadrats indicated that the unproductive quadrats were characterized by *Triodia* not more than 400 mm in height and perhaps low or sparse shrubs, e.g. *Trichodesma*, sometimes combined with a high percentage of bare or stony ground. The productive quadrats on the other hand were characterized by tall *Triodia* exceeding 400 mm in height, often augmented by shrubs, usually *Acacia bivenosa*, the whole providing good cover.

The height of the *Triodia* appears crucial.

COUNT B

During the second and third series of counts made in connection with Count A, birds observed outside of the quadrats were also counted irrespective of their distance from the quadrat limits. Birds counted within the quadrats were also included.

The figures provided by these 160 counts made at the 80 quadrat localities enable the species involved to be ranked by: (1) Number of times species recorded, and (2) Number of individuals recorded.

SURVEY B (1)—RELATIVE FREQUENCY OF SPECIES OBSERVED

(This table shows the times species recorded as a percentum of counts made, i.e., 160):

No.	Species	Percentum
1.	Spinifex-bird	84
2.	Singing Honeyeater	56
3.	Black-and-white Wren	43
4.	Welcome Swallow	19
5.	Horsfield Bronze Cuckoo	17
6.	Nankeen Kestrel	17
7.	Spotted Harrier	13
8.	Tree-Martin	11
9.	White-breasted Wood-Swallow	9
10.	Black-shouldered Kite	6
11.	Bar-shouldered Dove	4
12.	White-breasted Sea-Eagle	4
13.	Red-backed Sea-Eagle	3
14.	Osprey	3
15.	Austrelan Pipit	2
16.	Black-faced Cuckoo-Shrike	> 1
17.	Pallid Cuckoo	> 1
18.	Brown Hawk	> 1
19.	Grey-tailed Tattler	> 1
20.	Zebra Finch	> 1
21.	Silver Gull	> 1
22.	Pied Oystercatcher	> 1
23.	Sacred Kingfisher	> 1
24.	Caspian Tern	> 1
25.	Large Sand-Dotterel	> 1
26.	Sandpiper (sp)	> 1

SURVEY B (2)—NUMBER OF INDIVIDUALS RECORDED

No.	Species	Within Quadrat	Outside Quadrat	Total
1.	Spinifex-bird	59	324	383
2.	Black-and-white Wren	25	231	256
3.	Singing Honeyeater	8	125	133
4.	Tree-Martin	24	61	85
5.	Welcome Swallow	36	34	70
6.	White-breasted Wood-Swallow	12	29	41
7.	Horsfield Bronze Cuckoo	5	31	36
8.	Nankeen Kestrel	8	23	31
9.	Spotted Harrier	1	24	25
10.	Bar-shouldered Dove	0	14	14
11.	Black-shouldered Kite	0	12	12
12.	Pied Oystercatcher	1	6	7
13.	White-breasted Sea-Eagle	0	6	6
14.	Red-backed Sea-Eagle	0	4	4
15.	Osprey	0	4	4
16.	Australian Pipit	2	2	4
17.	Black-faced Cuckoo-Shrike	0	2	2
18.	Zebra Finch	0	2	2
19.	Silver Gull	1	1	2
20.	Large Sand-Dotterel	2	0	2
21.	Sacred Kingfisher	0	1	1
22.	Caspian Tern	0	1	1
23.	Grey-tailed Tattler	0	1	1
24.	Pallid Cuckoo	1	0	1
25.	Brown Hawk	0	1	1
26.	Sandpiper (sp.)	5	0	5
Two counts at each quadrat		Total 190	939	1129
Average of the counts		Total 95	469.5	564.5

COMPARISON BETWEEN *TRIODIA* AREA SURVEY RESULTS

In the following table the species logged in the main count, Count A, are ranked in descending order and the first eight selected, i.e., all species of which more than two individuals were recorded. This seemingly arbitrary procedure has the advantage of excluding all obvious stragglers to the *Triodia*.

The same species are then ranked in descending order according to their placement in Surveys B2 and B1.

SPECIES	A	SURVEY B2	B1
Spinifex-bird	1	1	1
Welcome Swallow	2	5	4
Black-and-white Wren	3	2	3
Tree-Martin	4	4	7
White-breasted Wood-Swallow	5	6	8
Singing Honeyeater	6	3	2
Nankeen Kestrel	7	8	6
Horsfield Bronze Cuckoo	8	7	5

A close agreement between Counts A and B2 is to be expected as both relate to individuals. A less close agreement between Count A and Count B1 is to be anticipated as the latter deals with species and might be expected to discriminate against species which occur in flocks. The Spearman's Rank Difference Correlation Co-efficient between the ranking of Count A and those of Count B2, as shown above, is 0.74; confidence level = 95%.

To obtain a co-efficient of Concordance between the three rankings, Kendall's version of the method was used, giving a co-efficient of 0.75, a measurement which can be accepted with a confidence level of between 95% and 98%.

However, it must be observed that the dropping of those species deemed to be stragglers to the *Triodia*, though reasonable to a field observer, is open to rather serious statistical objection.

NICHES WITHIN THE *TRIODIA* AREA

The following relatively small niches in the *Triodia* area appeared to warrant special examination. A summary of our observation in each follows.

Eucalypt Areas

There are on the island two small stands of *Eucalyptus patellaris* occupying steep slopes of rock and gravel. Few of the trees exceed five metres in height.

Both of these stands were examined. The only birds noted among the trees were Bar-shouldered Doves, Singing Honeyeaters and one Black-faced Cuckoo-Shrike. None of these species is confined to the eucalypt area. Two old nests, apparently of Bar-shouldered Doves, were located in the trees. However, the doves are not dependent upon the eucalypts for nest sites: elsewhere on the island they nest in *Ficus* and in rock recesses.

The flowering of the eucalypts is linked to the rainfall and the main season is between December and March, but flowering is not regular and may occur at other times (W.H.B.).

In short, the eucalypts appear to have no real significance to the avifauna. This is possibly because the niche is too small to support a resident population and too isolated to attract eucalypt-frequenting nomads.

Erythrina Areas

The island supports a few small stands of *Erythrina vespertilio* wind-pruned to heights of about three metres. Birds noted in these stands were Black-shouldered Kite, Singing Honeyeater, Horsfield Bronze-Cuckoo, Spinifex-bird, Black-and-white Wren and Zebra Finch. None of these is confined to the *Erythrina*. The presence of Spinifex-birds and Black-and-white Wrens is probably explained by the ground cover of *Triodia* which

persists under the *Erythrina* canopy. It would appear that the Zebra Finch favours the *Erythrina* as a nest tree: we located seven nests in one clump. *Ficus* (spp.)

Two species of *Ficus* occur distributed throughout the island and one would expect them to provide shelter, perches, nesting sites and a source of food for birds. Different clumps fruit at different times, providing a rotation. However, no bird species appears to have found much use for these trees and they are surprisingly little frequented except by Singing Honeyeaters which use them as song perches. W.H.B. has observed them catching insects in the clumps.

The Wapet Camp

WAPET Camp is reasonably compact, comprising two groups of huts, a mess and ancillary buildings and a grassed recreation area. The introduction of a few trees not native to the island has been permitted and there are now some River Gum, *Eucalyptus camaldulensis*, Coastal Moort, *Eucalyptus platypus*, and Tuart, *E. gomphocephala*, some of the latter up to six metres in height. The Camp has an adequate water supply and water can easily be obtained by wild life, e.g. at the swimming pool, though this was dry at the time of my visit. The recreation field attracts aerial feeders and W.H.B. has observed Little Whimbrel, Pipits and Magpie-Larks on this grassed area. Several bird species show some preference for the camp area, viz:

White-breasted Wood-Swallow: On one occasion, when rain threatened, c. 60 birds assembled in close formation on a radio aerial. This appeared to be most of the Camp population.

Silver Gull: Birds in the vicinity of the Camp rest at times on the beach nearby. On one such occasion we counted 430 birds.

Welcome Swallow and Tree-Martin: Both of these species occur throughout the island, but may often be seen in relatively large numbers about the Camp. On one occasion c. 40 Tree-Martins were present.

Nankeen Kestrel: A pair was in residence at the Camp.

Singing Honeyeater: This was a conspicuous bird about the Camp but the species is widespread on the island so the Camp population may not exceed average density by very much. Personnel provide food for the honeyeaters at the mess.

Bar-shouldered Dove: These birds are seen about the Camp, possibly attracted by water available.

Magpie-Lark and Black-faced Cuckoo-Shrike: Neither of these species is common on the island, but both were recorded at the Camp during the study period.

ASSESSMENT OF THE MARITIME BIRD POPULATION

Accessible beaches were visited and counts made of seabirds and shorebirds present. This survey was limited to the period August 3 to August 13, having in mind possible changes in the occurrence of migratory waders. No significant changes in the composition of the wader population were evident during that period. The beaches examined are representative and include sandy shorelines, inshore reefs, muddy flats, a coral reef, rocky cliffs and parts including some of the very limited mangrove areas. An effort was made to ensure that the representation of the main types of habitat was proportional.

The total shoreline of Barrow Island, as measured on the map is 84 km. Beaches examined during the survey period total 28 km, i.e. one-third of the whole.

CENSUS C. — ANALYSIS OF THE MARITIME BIRD SURVEY

The total number of birds of each species seen in all counts—21—was multiplied by three (the fraction of the shoreline examined being one-third of the whole) to give a total population figure. The results are summarised in the following table.

COUNT C — MARITIME BIRDS

[illegible]

FURTHER OBSERVATION ON BEACHES

As indicated, survey counts of maritime birds were cut off on August 13 as it was felt that at this season migrants would be moving in, distorting any generalizations made from a more extended survey.

No further work was projected, though it was not ruled out. In the event, persistent winds during the period August 23 to August 26 made work on terrestrial birds largely futile, so time was spent on some of the more sheltered beaches. Ultimately, not only was the whole shoreline seen from a helicopter but practically the whole was inspected from the ground.

Observations made at this period suggest that a migratory movement was in progress; birds in transition plumage were not uncommon and some species not recorded earlier, or recorded only in small numbers, were encountered fairly frequently.

Initially the term "beaches" was used to embrace the whole shoreline and typical stretches were examined to give a proportional representation of sand, reefs, cliffs and mangroves.

In view of the later observations an elaboration may be desirable.

Cliffs

These are mainly on the central part of the west coast where they comprise 28% (9 km) of this coastline. As remarked by Scriveny *et al*, (1971, p. 13): "Australian sea birds have not exploited the cliff-nesting niches," and this cliff area supports little bird life other than oystercatchers and Reef Herons on wave-cut platforms, and Kestrels, Ospreys and White-breasted Sea-Eagles on the cliffs.

Coral Reefs

The main coral reef, at Turtle Bay, appears to attract few individual birds but several species of waders and sea-birds were noted.

Sandy Beaches

These are visited by gulls and terns and a few waders, e.g. Red-capped Dotterel.

Inshore Reefs

These make up a high proportion of the shore line and are attractive to almost all of the shore birds. The reefs on the east and south coasts collect a certain amount of alluvial mud and are especially attractive to birds and, indeed, other forms of life, upon which they probably prey. Mangroves appear in association with these reefs.

Mangroves

There are several small stands of mangroves, *Avicennia*, the most consequential near Stokes Point and at the mouth of Donald River, a tidal creek, but even these are quite small. Some mud persists at Donald River and in a limited area at Stokes Point, but generally sand has accumulated and it would seem that these are declining communities. Small populations of molluscs associated with mangroves were noted, viz: *Terebralia sulcata*, *T. palustris* and *Melaraeph scabra*.

Although I have considered the Mangroves as a niche of the littoral zone, it is also linked to the *Triodia* habitat in that it provides perching and nesting resources for certain birds of the *Triodia* association.

Limited as the mangroves are, they appear to have some significance in relation to the avifauna e.g.,

Mangrove Heron appear to be tied to this habitat.

Yellow Silver-eye when they appear on the island frequent mangrove trees.

Red-backed Sea-Eagles nest in the mangroves, though not exclusively.

White-breasted Wood-Swallows appear to favour mangrove areas though they are widely distributed on the island.

Sacred Kingfisher though also not restricted to the mangroves, appears to favour these areas and would probably be rare on the island if mangroves were not present.

OFF-SHORE ISLETS

As it was practicable to visit only two of the islands adjacent to Barrow Island, it has been deemed desirable to deal with these separately from the main island. Both were visited on August 19.

DOUBLE ISLAND

Birds noted were:

Wedge-tailed Shearwater.

Pied Cormorant: There appeared to be c. 60 on or about the island.

Reef Heron: Two grey-phase birds were noted in flight and a single bird—possibly one of the two—was seen on a shore reef.

Osprey: Two adults were present about a nest on the rocky cliff top towards the north end of the southern portion of the island. This nest contained a very young chick and two eggs. A number of ants were crawling over the chick but it did not seem distressed.

Black-shouldered Kite: Three birds, all apparently adult were seen perched on a clump of *Ficus*.

Pied Oystercatcher: Three were present, mainly in the area between the two sections of the island. W.H.B. found a nest with egg.

Sooty Oystercatcher: Two seen, close to the fore-going.

Silver Gull: The few present were scattered and the number hard to assess—perhaps 20 in all.

Caspian Tern: Two present.

Bar-shouldered Dove: Two were seen near a thicket of *Acacia coriacea*, but W.H.B. reported a flock of 18 and other small groups—perhaps 40 in all.

Spinifex-bird: Located in the larger *Triodia* clumps.

Singing Honeyeater: Noted. The birds seem to show some preference for the thicket mentioned in the note on Bar-shouldered Dove.

MUSHROOM ISLAND

Pied Cormorant.

Reef Heron: One noted in flight.

Osprey: One in flight over island.

Silver Gull: A few scattered birds were present. The eastern part of the island appears to have been the site of a rookery if one can judge by the general appearance and the bones and feathers present. Little cover remains, so the area may no longer be used.

Caspian Tern: Two adults and two chicks noted.

Fairy Tern: Nesting colony observed. See species list.

Crested Tern: One: lemon-yellow bill noted.

Bar-shouldered Dove: Noted.

Welcome Swallow: Two seen singly.

Singing Honeyeater: One seen.

OTHER MAJOR HABITATS

The *Triodia* and the littoral areas having been covered, two major areas remain—the claypans and the sandhills.

Claypans

There is a claypan in the north of the island and four claypans in the south. Except for a few small ephemeral pools following a shower these were dry at the time of the investigation and were covered with dry *Agrostis* (spp.).

Triodia does not invade the claypans.

Not surprisingly, Australian Pipits favour these areas and we noted Zebra Finches at temporary pools on August 16 following rain on the previous day.

W.H.B. has noted that after rain has flooded the claypans, water-frequenting birds move in temporarily.

The Sandhills

The sandhills appear to lack a specialized avifauna, the species present being an extension of the *Triodia* association. However, W.H.B. points

out that this area is important as both a feeding and a nesting area, notably for Bar-shouldered Doves. The *Acacia coriacea* thickets provide perching and foraging areas for the doves and Black-and-white Wrens in particular and calling points for territorial Spinifex-birds. The sand-hills appear to be favoured by foraging Accipitriformes. The nesting of Ospreys in this area has already been recorded.

THE FUTURE OF BARROW ISLAND

The question of guarding national parks and fauna reserves from outside pressures, e.g. the pressures of private enterprise and of 'public interest', is beyond the scope of this report but is one which governments and people need to consider urgently. It is doubtful whether we can afford *not* to examine our natural resources and carefully plan and control land usage. The setting aside of adequate areas for recreation, flora and fauna reserves and wilderness areas in a wide range of habitats would be part of such a plan. With sound planning the chance of conflict between legitimate interests would be reduced to a minimum.

In the meantime, I concur with the views expressed in an unpublished report "Formal Report on Conservation and Industry, Barrow Island Oilfield" by W. H. Butler, 1970, and quote:

"At no time should the example of Barrow Island and WAPET be regarded as a precedent for such alienation on the mainland as a mainland end result would be very different from the one obtained on Barrow Island. All islands have certain advantages: There are no weeds so that soil disturbance does not result in a complete change in vegetative components as on the mainland. Similarly no animal predators or competitors can invade from the outside. Perhaps as important as these two facts is that the mining company on the island has complete control of all human access, a state not possible on the mainland. In addition Barrow has an advantage over other islands in its size. A similar operation on a smaller island could have disastrous results. Finally as compared to major disturbances under more extensive mining operations, it must be realized that oil drilling comes in the category of intensive mining which may use large areas with minimal disturbance."

I have one reservation. Butler states: "All islands have certain advantages . . ." a statement which he proceeds to justify. I would add "And all islands have disadvantages".

James Greenway (1967, p. 7) summarizes the bird species which have become extinct in fairly recent times. Of 42 species only two were continental species (both North American). *The remainder were island populations.*

Butler's report emphasises the need to conserve the flora of the island with particular attention to the dominant *Triodia* spp.

If the safeguards which are at present being implemented are conscientiously maintained I see little danger to the avifauna of the island. The requirements of all forms of vertebrate fauna appear to be quite similar.

It is to be hoped that when the oilfield is worked out, the island with its splendid potential as a conservation reserve will be upgraded and managed to provide maximum protection of the fauna, and of the flora upon which the fauna depends absolutely, and that the island will be preserved as a unique unit in our national heritage.

REFERENCES

- BURBIDGE, A. A., and A. R. MAIN. 1969. Report on a Visit of Inspection to Barrow Island November, 1969. *Department of Fisheries and Fauna*, Report 8.
- BUTLER, W. H. 1970. A summary of the Vertebrate Fauna of Barrow Island, W.A. *W. Aust. Nat.*, 11 (7): 149-160.
- BUTLER, W. H. 1975. Additions to the Fauna of Barrow Island, W.A. *W. Aust. Nat.*, 13 (4): 78-80.
- BUTLER, W. H. 1975a. *Barrow Island*. W.A. Petroleum Pty. Ltd., Perth.
- FISHER, James, 1947. *Bird Recognition*, vol. 1. Penguin.
- GREENWAY, J. C., Jr. 1967. *Extinct and Vanishing Birds of the World*. Dover.
- HAVILAND, M. D. 1926. *Forest, Steppe and Tundra*. Cambridge University Press.

- SCHODDE, R. 1975. *Interim List of Australian Songbirds—Passerines*. R.A.O.U.
- SERVENTY, D. L., and A. J. MARSHALL. 1964. A Natural History Reconnaissance of Barrow and Montebello Islands, 1958. *Tech. Paper No. 6, CSIRO Div. Wildl. Res.*
- SERVENTY, D. L., and H. M. WHITTELL. 1976. *Birds of Western Australia*. 5th edn. Univ. of W.A. Press, Nedlands.
- WHITLOCK, F. L. 1918. Notes on North-western Birds. *Emu*, 17 (4): 166-179.
- WHITLOCK, F. L. 1919. Notes on Birds Breeding in Dampier Archipelago, N.W. Coast of Australia. *Emu*, 18 (4): 240-253.

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POSTSCRIPT

In my Barrow Island study I have confined my observations to my subject—the avifauna, and this applies to my remarks on the future of Barrow Island in the post oil extraction period. However, it has been demonstrated that the island has an important and spectacular mammalian fauna and a reptilian fauna rich in individuals and species, Butler, *W. Aust. Nat.*, 11 (7): 149-160 and 13 (4): 78-80; Smith, *W. Aust. Nat.*, 13 (6): 125-136. The marine fauna is perhaps no less important; the coral reefs, for example, though not extensive are of splendid quality.

The introduction to the Australian section of *The World Wildlife Guide*, 1971, edited by Malcolm Ross Macdonald, Threshold Books, London, was written by Elspeth Huxley, who makes these points (among others):

(1) "Conservationists face a number of problems unique to Australia. The continent has few 'natural' wildlife parks—isolated swamps, inaccessible jungles, remote mountains and tablelands—so that every wildlife area is created in potential competition with other land users."

(2) "... there are such human factors as the country's jealously guarded state autonomy ..."

(3) "The idea of a large national park system is only beginning to catch on in Australia. Many of them are aimed more at recreation than conservation."

When the time comes, wildlife conservationists will need to anticipate pressures to convert Barrow Island into another tourist resort with all facilities and amenities and to ensure that the island's economy is not disturbed by development and over-use. Utilized predominantly as a recreation area, the island could easily lose its insular advantages and the flora and fauna suffer the fate of that of so many of the world's islands.